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(56) Documents Cited
GB 2322456 A GB 2264792 A GB 2173319 A
GB 2140930 A GB 2136147 A GB 2099605 A
US 5551968 A

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(54) Abstract Title

Gap or lens located between two optic fibres to prevent heat spot damage

(57) Optic fibres 9 and 10 are separated by a gap 8 which dissipates the heat formed by the transmitted light 11. A lens 12 may also be placed between the two optic fibres so that when light is transmitted from light source 13 the light is de-focussed and therefore prevents fibre optic damage. Another embodiment is the addition of a different type of glass in place of the gap which also acts to de-focus the transmitted light.

A further embodiment is to taper the optic fibre clad 5 and core 3 as shown in figure 2. The stated affect is the expansion of small spot 4 to a bigger spot 6 which will also dissipate the heat.

In a further embodiment detection means is provided so that the light can be automatically switched off if fibre optic damage is detected.

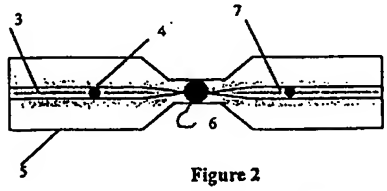

Figure 2

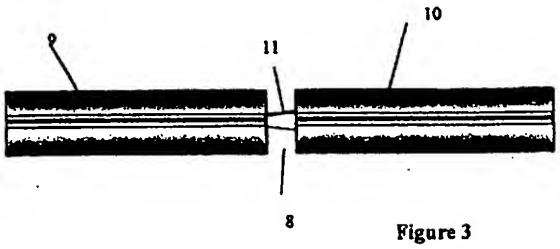

Figure 3

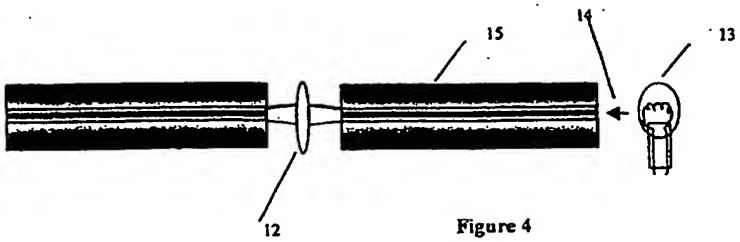

Figure 4

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

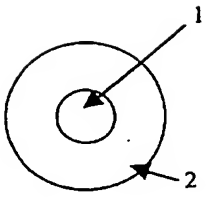

Figure 1.

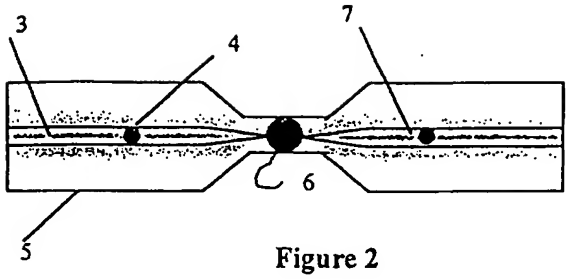

Figure 2

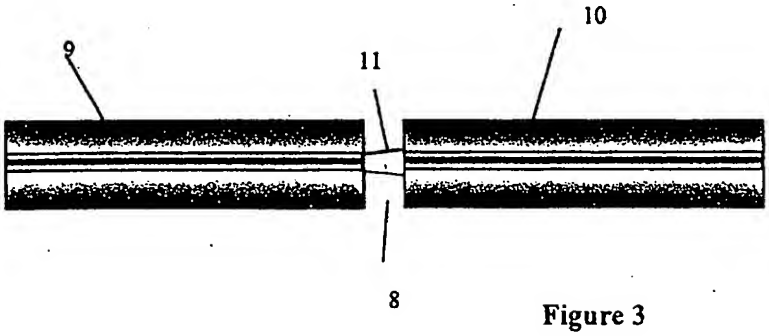

Figure 3

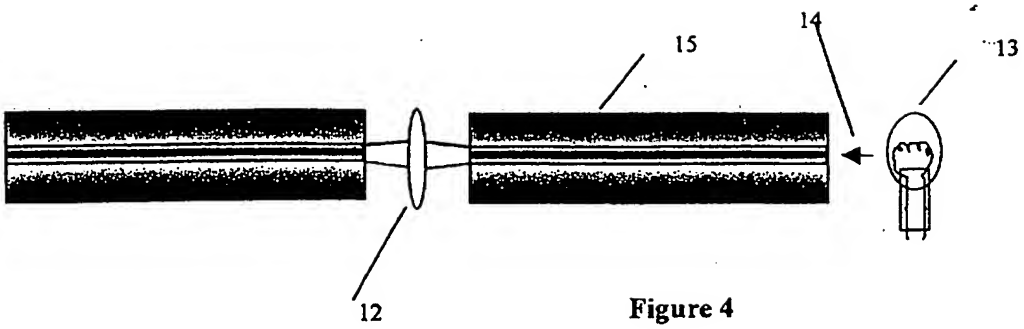

Figure 4

Stopping optical fibre damage dead in its tracks: Damage catcher

Optical fibres used for communications can be easily damaged by the light carried in them, if, for example, the fibre end comes into contact with something that absorbs the light [Kashyap R, "Self-propelled self-focusing damage in optical fibres", in Proceedings of The Xth International Conference on Lasers, Stateline, Lake Tahoe, Nevada, USA, Ed F J Duarte, STS Press, 7-11 December 1987, pp859-866, also Kashyap R and Blow K J, "Observation of catastrophic self-propelled self-focusing in optical fibres", *Electron. Lett. 29* (1), pp. 47-49, 7 January 1988.]. This is true when the amount of light in the fibre is really quite small. Compared to an ordinary 100W light bulb, the amount of light needed to damage the fibre end is less than 1 W [See previous articles]. My Dad discovered this effect many years ago, and I saw a video of how this damage starts and moves. Ask my Dad and he will show it to you and I am sure your jaw will drop open because it is very pretty. When this damage occurs, the fibre heats up and can absorb the light it is carrying. When this happens, the fibre heats up even more and the surrounding fibre gets hot, it also starts to absorb light so that the damage continues till all the fibre is damaged. At the damage there is a pretty, bright bluish glow which moves quite fast and looks like the fibre is burning. I saw a long piece of fibre "burnt-up" like this in the video. But you can also stop the "burning" by turning off the light in the fibre. If this damage happens in optical fibres that carry telephone conversations or internet messages, it could be difficult for people and computers to talk to each other and take a long time to replace the damaged fibres. I think if a digger dug up a cable in the ground and broke the fibre, mud could get on the end of the fibre and start the damage.

The fibre can be damaged so easily because the light in it is like a focused spot and it is also at the end of the fibre, like sunlight gets focused through a lens. When sunlight is focused to a small spot, it can make a piece of paper catch fire. In the same way, anything that comes into contact with the tiny spot at the end of the fibre can be damaged if it absorbs the light. The fibre itself is very transparent most of the time until it becomes hot, when it starts absorbing as well.

I thought up ideas how you could stop this damage while I was away on holiday with my mum and dad. I now describe an idea which will prevent this damage from continuing and show how it can work. Like the lens and sunlight, if the focused spot is too large, the absorption is over a large lump of absorbing paper (or anything else), and so the paper (or something else) will not get too hot. So if a fibre has a large spot, and it comes into contact with paper, the paper will not burn and not damage the fibre end. My idea is to make a gadget that changes the spot in the fibre so that over a small length (maybe a few millimetres long) it becomes bigger than in the rest of the fibre, before returning it to its normal size. The reason is that if a fibre has been damaged and the damage is moving towards the place where the light is coming from, it will reach the gadget where the spot will be made bigger so that more of the fibre has to be heated by the light. This will make the fibre cooler and then stop the damage.

I will now tell you one way how this may be done. A fibre or a light guide has a core 1 and a cladding 2, usually made out of glass, as shown in Fig 1. The core keeps the light inside it. My dad told me that the spot of light is similar to the size of the core. So make the core slightly bigger, by joining a different fibre with a bigger core to it. If the spot in this fibre is big enough (twice the size means four times the area, so that four times larger piece of fibre has to be heated), the damage will stop if the fibre does not heat up enough. There may be other ways of doing the same thing. My dad says that it is already known that if you made the fibre core disappear slowly by heating it and stretching it, the spot in the fibre can become bigger. This is shown in Figure 2 in which the normal fibre has a small spot 4,7 and the narrower fibre has a bigger spot 6. Of course, where the fibre is very thin 6, it may blow-up from the heat and break the fibre and then stop the damage. So, another way to stop the heat from moving along the fibre is to put a gap and use a lens to put light from one fibre to the other. Figure 3 shows two fibres 9,10 separated by a small gap 8 without lenses. Light 11 jumps from one fibre to the other across the gap, but does not pass the heat. It may be easier to do this with a lens 12 in the gap shown in Figure 4, and with two lenses, you could put other things in there, like small mirrors to measure the light.

If you can detect the bright light of the damage somewhere in the fibre, then you could switch off the light 13 (which is coupled 14 to the fibre 15) in the fibre before the damage continues and destroys all the fibre and other things connected to it. You could use a solar cell to measure the light 13. You could also use the light detector near the thin fibre 6. By bending it so it could measure the light when the damage gets to the thin fibre 6 and then switch the light off.

I have also see that sometimes when things get hot, the light coming through it looks funny. Like when you heat water, the bottom of the pan can look strange and bent. If there is a glass which can be made into a fibre and this glass makes the light in it de-focus when it gets hot, it would also help stop damage in the fibre. So a short piece of fibre made of this glass get hot when the hot damage gets to it, it will immediately make the light de-focus and let the fibre cool down and stop the damage from moving.

CLAIMS:

1. I claim a device that can stop optical fibre or light guide damage from continuing to where the light is coming from,
2. I claim many ways of doing this, for example by cutting an optical fibre or light guide and putting a gadget that can allow the light to jump across the gap (for example by a lens), but stops the heat from getting through, or by using a very small gap without a lens,
3. I claim a gadget that changes the spot in an optical fibre or light guide such that over a short length it is bigger than it is in the rest of the fibre or light guide; any damage moving in the optical fibre or light guide will stop here because the optical fibre or light guide does not heat up enough,
4. I claim an optical fibre or light guide or any other gadget which allows light to be kept inside like in a fibre, in which the core is made bigger or smaller to allow the spot to be changed over a short distance, for example about 5 millimetres,
5. I claim any of the above may be used to protect any precious things that may be used with optical fibres or light guides; my dad says that there are amplifiers and lasers used in telephone cables with optical fibres and light guides which I think may need protection from this type of damage,
6. I claim a new type of optical fibre or light guide made of different glasses which makes the spot inside it bigger if it gets hot; if the damage starts, it will stop automatically when it reaches this optical fibre or light guide because it does not heat up enough to absorb the light,
7. I claim that you can use a small piece of the glass as in claim 6 in the gap between two ends of optical fibres or light guides,
8. I also claim that the damage in the optical fibre or light guide may be detected by a detector at or near the gadget that stops the damage, so that a switch may be turned to switch off the light automatically to stop more damage from happening.

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Application No: GB 9926604.1 **Examiner:** Andrew P Jenner
Claims searched: 1 - 7 **Date of search:** 15 January 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): JGAT, JGEB, JGEAS, JGEA9, JGEAX1, JRF

Int Cl (Ed.7): G02B

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2322456 A	SAMSUNG ELECTRONICS CO. LTD. - see lens in figures	1 - 3, 5
X	GB 2264792 A	BT PLC. - see removed section 100 in figures 7 and 8	1 - 3, 5 - 7
X	GB 2173319 A	KINUAT INSTRUMENTS LTD. - see predetermined space 15 in figure	1 - 3, 5
X	GB 2140930 A	NORTHANTS AFORM LTD. - see tapered optical fibre 10 in figure 1	1, 3 - 4
X	GB 2136147 A	RAYCHEM CORP. - see gap between fibres on page 3 lines 14 - 20	1 - 3, 5
X	GB 2099605 A	RAYTHEON CO. - see gap between optical fibre faces 99 and 99a in figure 4	1 - 3, 5
X	US 5551968 A	JING-JONG PAN - see tapered optic fibre 11 forming a microlens in figure 2	1 - 5

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.